

5.0 OTHER HAZARDS

The likelihood of occurrence is determined for each hazard based on the probability of a major hazard event occurring within Benton County within the next five years. Probability of occurrence is categorized as:

- **High:** Great likelihood that a major hazard event will occur within the five year planning cycle.
- **Medium:** Moderate likelihood that a major hazard event will occur within the five year planning cycle.
- **Low:** There is little likelihood that a major hazard event will occur within the five year planning cycle.

Three hazards – floods, wildfires, and windstorms - have been determined to have a high likelihood of occurring within the next five years, and are evaluated in detail in Chapter 4.

Other natural and technological (e.g., man-made) hazards were determined not to have a high likelihood of occurring within the next five years. These other natural and technological hazards (listed below) were not subject to detailed characterizations or risk analyses at this time. Additional analyses to further characterize the risks of these other hazards will be conducted in the future based on periodic reviews of this Plan and available resources

Other Natural Hazards

- Landslide (e.g., slope stability)
- Severe Winter Storm
- Earthquake
- Volcano (e.g., ashfall)
- Drought

Other Technological (e.g., Man-Made) Hazards

- Civil Disturbance
- Hazardous Materials & Chemicals
- Pipelines
- Radiological
- Terrorism
- Transportation
- Urban Fire
- Other Local Hazard (Hanford Site)
- Other Local Hazard (Umatilla Chemical Depot)
- Other Local Hazard (Columbia Generating Station)

The following sub-chapters provide a preliminary introduction into these other hazards, presenting their likelihood of occurrence categories, and some readily available hazard characterization information. Complete hazard characterization and risk analyses for these hazards are not provided; many chapter headings are left blank, e.g., to be determined later.

5.1 LANDSLIDES

A major landslide hazard event has been determined to have a **Low** likelihood of occurrence in Benton County within the five-year planning cycle of this Plan. Therefore, although some hazard characterization information is presented below, no further risk assessment has been performed for landslide hazards. Additional analyses to further characterize the risks of this hazard and the development of suitable mitigation action items will be conducted in the future based on periodic reviews of this hazard mitigation plan and available resources

5.1.1 Nature of the Hazard

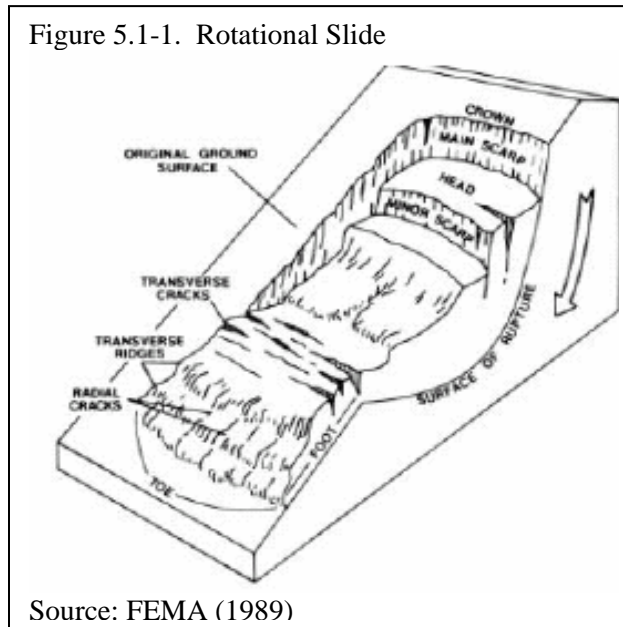
Landslides can be grouped into two categories: (1) rapidly moving, and (2) slow moving. Rapidly moving landslides present the greatest risk to human life, and people living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Slow moving landslides can cause significant property damage, but are less likely to result in serious human injuries.

Historical Events

A review of historical landslides has not been conducted for Benton County.

Landslide Characteristics

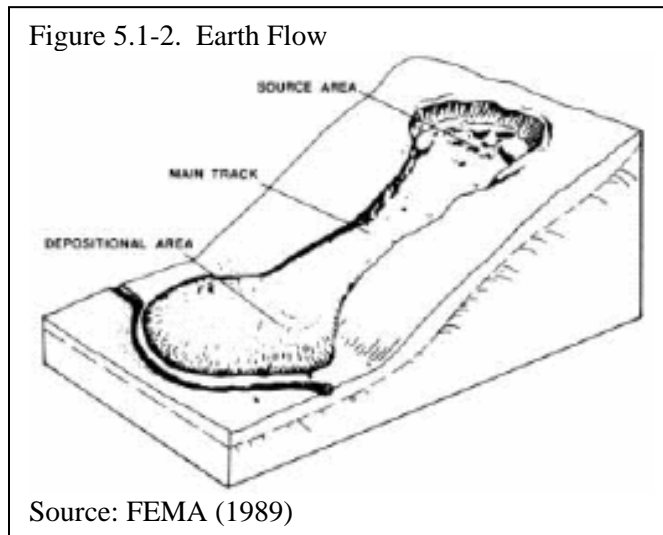
Figure 5.1-1. Rotational Slide



Landslides are downhill movements of rock, debris, or soil mass. The size of a landslide usually depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of rock and soil, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics. Two types of landslides in Benton County include slides and earth flows.

Slides move in contact with the underlying surface (Figure 5.1-1). These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep-seated. Slumps are small rotational slides that are generally shallow. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.

Earth flows are plastic or liquid movements in which soil and/or rock breaks up and flows during movement (Figure 5.1-2). Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel. Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances. Earthquakes can trigger these flows.



Landslides are typically triggered by periods of heavy rainfall or rapid snowmelt. Earthquakes and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid. Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road

construction and development can increase slope steepness. Grading and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities effecting landslides include: excavation, irrigation, drainage and groundwater alterations, and changes in vegetation.

Natural processes can cause landslides or re-activate historical landslide sites. The removal or undercutting of shoreline-supporting material along bodies of water by currents and waves produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes. Landslides are particularly common along stream banks.

Locations at risk from landslides include areas with one or more of the following conditions:

- On or close to steep hills;
- Steep road-cuts or excavations;
- Existing landslides or places of known historic landslides (such sites often have evidence of past movement such as tilted trees, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels; and
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons.

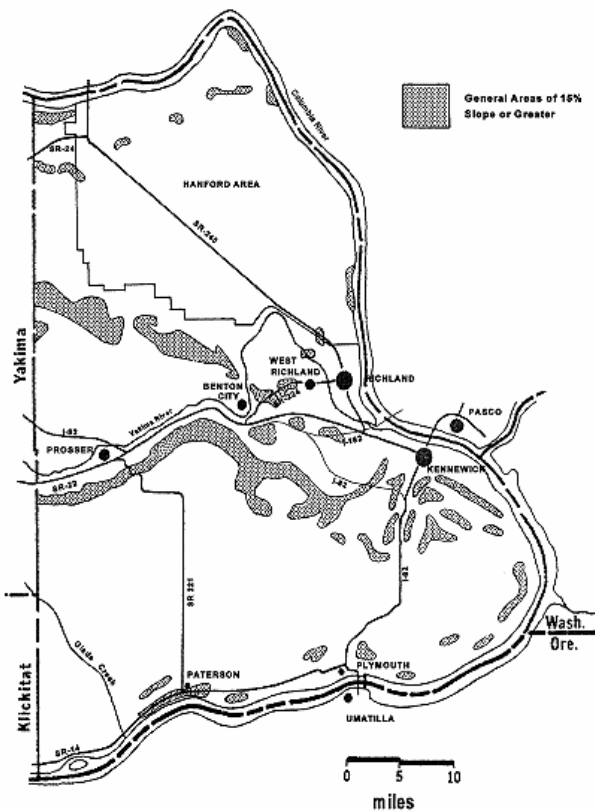
In planning and engineering, slopes are typically described as a percentage figure reflecting the change in elevation divided by the distance. For example, an area with a 15-foot change in elevation over a 100-foot distance is said to have a slope of 15 percent. As a comparison, the maximum slope on interstate freeways is 6 percent.

5.1.2 Hazard Assessment

Hazard Identification

Several factors, such as rainfall levels, vegetation cover, soil depth and geology, affect the stability of slopes. However, it is generally true that as slopes increase in steepness, there is a corresponding increase in the potential for instability. The Benton County Planning Department has identified those areas in the County with slopes in excess of 15 percent as areas of potential slope instability and erosion.

Figure 5.1-3 Steep Slopes in Benton County



Source: Benton County Comprehensive Plan

Figure 5.1-3 shows there are two major areas of steep slopes (greater than 15 percent) in addition to numerous smaller areas within Benton County. The two major areas are:

The north and northeast slopes of the Horse Heaven Hills that extend across the midsection of the County from the Yakima County line west of Prosser to the Columbia River southeast of the City of Kennewick, and

The Rattlesnake Hills which run in a northwest-southeast alignment along the southwestern boundary of the Hanford Site, and include Red Mountain, Candy Mountain, Badger Mountain, and other hills, that extend to the western part of the City of Kennewick.

Slopes of 50 percent can be found in both the Rattlesnake and Horse Heaven Hills.

Landslides in Benton County would most likely be slow-moving slumps,

although rapidly moving debris flows can result from the sudden release of water from broken pipes, tanks, or canals.

Vulnerability Assessment

Benton County is vulnerable to landslide hazards under the proper conditions, especially in the steeper slope areas shown in Figure 5.1-3. In response to market conditions, competition among competing land uses, and as higher income households target view lots on slopes and ridges, new residential developments in Benton County are increasingly occupying the more geologically complex terrain. These are the areas that present problems associated with slope stability.

Risk Assessment

A risk assessment has not yet been conducted for landslide hazards in Benton County.

5.1.3 Community Issues

Current Conditions

Due to the unique problems inherent in development in steeply sloping areas, special care must be exercised in the planning and development of such areas. Benton County's Comprehensive Plan Land Use Map identifies lower rural densities for steeply sloping areas and the Critical Areas Protection Ordinance applies performance standards to development within these areas. While not prohibiting development, the ordinance does require that the nature and severity of the hazard be identified and that the siting, design and engineering for development directly respond to the identified hazards, so that long term structural integrity can be reasonably assured (Benton County Comprehensive Plan).

Ongoing Mitigation

The County's Comprehensive Plan has identified the following action items to mitigate the potential effects of landslides on future developments.

- Apply an overall rural density which reflects the geologic constraints of the land;
- Encourage cluster developments that transfer allowable density from areas with steep slopes to areas on the same parcel with less hazardous building conditions;
- Require accurate technical characterization of site conditions; and
- Require the application of design and engineering measures tailored to site conditions in order to assure long term structural integrity both on and off-site, and to protect public health, safety, and welfare.

5.1.4 Mitigation Strategies

Mitigation strategies for landslide hazards have not yet been developed as part of this Hazard Mitigation Plan.

5.1.5 Resources

State Resources

Washington Department of Natural Resources, Division of Geology and Earth Resources

The Geology and Earth Resources Division is Washington's geological survey. It is an excellent reference source for information about the geology of Washington. The Division compiles and publishes geologic maps, provides information about the geology of the state, including resources, hazards, and basic geology, and offers applied geological and geotechnical services to the public, government agencies, and universities.

Contact: DNR, Division of Geology and Earth Resources

Address: 1111 Washington Street SE, Room 148, PO Box 47007, Olympia, WA 98504-7007

Phone: (360) 902-1450

Website: <http://www.dnr.wa.gov/geology/hazards/lslides.htm>

Federal Resources

Natural Resource Conservation Service (NRCS)

The NRCS produces soil surveys. These may be useful to local governments who are assessing areas with potential development limitations including steep slopes and soil types. They operate many programs dealing with the protection of natural resources.

Contact: NRCS, Prosser Service Center

Address: 618 8th Street, Prosser, WA 99350-1444

Phone: (509) 786-1923

Fax: (509) 786-1175

Website: <http://www.wa.nrcs.usda.gov>

US Geological Survey, National Landslide Information Center (NLIC)

The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.

Contact: National Landslide Information Center

Phone: (800) 654-4966

Website: <http://landslides.usgs.gov/>

Additional Resources/Literature Cited

Benton County Comprehensive Plan, June 22, 1998.

FEMA, 1989, *Landslide Loss Reduction*, FEMA 182, Federal Emergency Management Agency, Washington, D.C.

Radbruch-Hall, D.H., R.B. Colton, W.E. Davies, I. Lucchitta, B.A. Skipp, and D.J. Varnes, 1982, *Landslide Overview Map of the Conterminous United States*, U.S. Geological Survey Professional Paper 1183.